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(54) **Sealing liner, Particularly for eliminating infiltrations.**

(57) The liner has a composite pack-like structure with an intermediate support (11) made of geocompatible textile material having a high degree of mechanical strength, and two layers (12-13) of water-expandable material. Each layer of water-expandable material is delimited by further surface containment layers (14-15) which are also made of highly permeable geocompatible textile material.

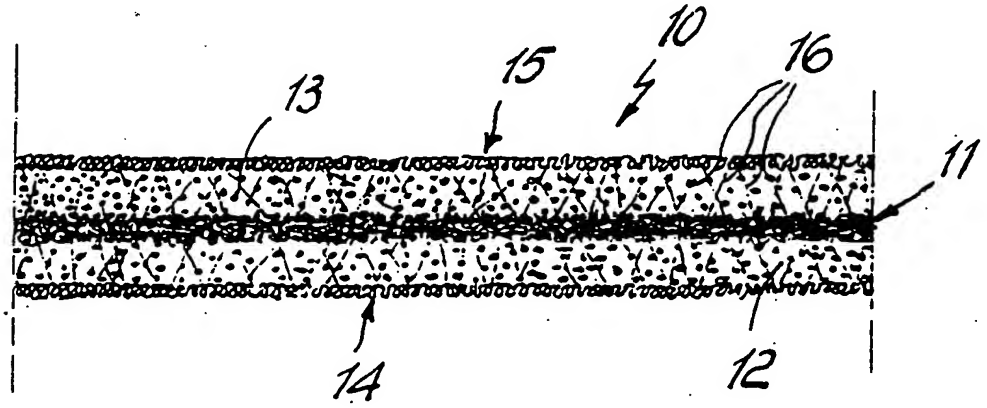

Fig. 1

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The present invention relates to a sealing liner particularly for eliminating infiltrations.

As is known, in many fields of civil and hydraulic engineering there is the problem of sealing structures, basins, containment embankments and the like in order to prevent both infiltrations of liquids into the ground and the rise of groundwater.

The sealing of collection basins of landfills for solid and liquid urban and industrial waste in order to prevent the infiltration of polluting liquids into the ground is particularly important.

Sealing liners for eliminating infiltrations, to be used in combination with membranes or other liquid containment linings, are already known; said liners are constituted by the association of geocompatible textile material and of water-expandable material. In the specialized literature, the term "geocompatible textile material" defines a textile product whose physical, mechanical and hydraulic properties are such that it can be used in contact with the ground. Generally, geocompatible textile materials are constituted by woven fabrics, by non-woven fabrics (hereinafter referred to by the abbreviation NWF), thick flock felts and nets, all made of a polymeric material, particularly polypropylene, polyester and nylon. The water-expandable material is typically constituted by sodic or calcic bentonite, possibly with additives.

Known liners of the specified type are laid directly on the ground, and membranes or other liquid-containment and - retention layers are placed over them in the case of tanks, basins and the like. The essential function of said liners is to prevent leaks of liquid into the ground if the membranes split or if the overlying layer cracks, or to prevent the rise of groundwater which might generate pressure from below and damage the containment layers or membranes. They also have a mechanical function of retention and support for the membranes, which generally have modest self-support characteristics.

Currently, said known liners are composed of a sandwich with two layers of geocompatible textile material. The water-expandable material is inserted between the two layers and kept in place by adhesive and/or by long stitches or tacks. The layers of geocompatible textile material are differentiated, in that one of them, made of tight-mesh woven fabric, or of NWF and the like, has high mechanical strength, to the detriment of permeability, in order to provide the liner with a corresponding mechanical strength, whereas the other layer, generally made of loose-mesh gauze woven fabric, is highly permeable and has the sole purpose of containing the layer of water-expandable material.

These known liners are installed with their permeable face directed toward the neighboring liquid, so that any leaked liquid, by passing through the permeable layer, can reach the bentonite and cause its expansion in order to provide a tight seal.

The greatest problem of these known liners consists of the different degrees of permeability of their two sides, which, due to this reason, do not prevent leakage of neighboring liquids towards the ground and, at the same time, of any liquids which might rise from the ground itself. Furthermore, since the lining layers are obtained by arranging side by side a plurality of strips of said sandwich material unrolled from rolls and by partially overlapping the adjacent strips, due to the different nature of the layers of geocompatible textile material, the mechanically strong and scarcely permeable layer of one strip partially overlaps the permeable layer of the adjacent strip in the regions where the strips overlap or surmount one another. Therefore, in this overlap region, the water-expandable material, being compressed between two scarcely permeable layers, is not reached by any infiltration liquids and thus cannot expand in order to perform its sealing function. The overlap regions of the strips are therefore critical in terms of the impermeability of the layer, and is a further severe problem in the use of known liners.

The aim of the present invention is to eliminate the problems encountered in the use of the known sealing liners.

Within this general aim, an object of the invention is to provide a sealing liner which has great mechanical strength and, at the same time, a similar permeability and therefore a similar ability to absorb and retain infiltrations on both of its sides. The liner according to the present invention therefore constitutes an effective barrier both against infiltrations directed toward the ground and against infiltrations which rise from the ground.

Another important object of the present invention is to provide a liner which is structured so as to also seal, in the presence of infiltrations, the overlap regions of the adjacent strips which form a sealing layer.

A further important object of the present invention is to provide a liner with selective sealing, wherein the term "selective" defines the ability of the liner to interact with liquids of different kinds so that, for example, one side of the liner is suitable to cutoff fresh-water infiltrations and the other side is suitable to cutoff infiltrations of chemically active liquids or of sea water or of percolation liquids.

In order to achieve this aim, these important objects and others which will become apparent from the following detailed description, the present invention provides a sealing liner, characterized in that it comprises a composite pack-like structure having an intermediate support made of geocompatible textile material with predominant mechanical strength which separates two layers of water-

expandable material, each one of said two layers being delimited by respective further outer containment layers made of highly permeable geocompatible textile material.

The intermediate layer is provided so as to impart to the liner a high-degree of mechanical strength and self-support. The two water-expandable layers are provided in order to give the liner the ability to prevent the passage of liquids migrating in opposite directions.

Preferably, the intermediate support is constituted by a flocked geocompatible textile material with a high imbibition power, with a unit weight comprised between 150 and 1000 grams per square meter. A layer of NWF based on nylon pretreated in a hot-air oven has been found to be particularly suitable for this purpose.

The material of the expandable layers is typically constituted by sodic bentonite (montmorillonite) or calcic bentonite, possibly with the addition of synthetic expanding agents which can be chosen according to the required sensitivity of the layers to specific liquids or compounds dissolved in them.

The outer containment layers are preferably constituted by loose-mesh fabric, typically geocompatible textile gauze, made of spun or flocked polypropylene or polyester.

Preferably, the expandable material is in granular form, with a grain size comprised between 5 and 40 mesh, and is kept in place by tacking and/or by non-toxic adhesives (e.g. fish glues) which prevent said granular material from concentrating by gravity when the liner is installed in vertical or almost vertical arrangements.

Further characteristics and advantages will become apparent from the following detailed description and with reference to the accompanying drawings, given by way of non-limitative example, wherein:

figure 1 is an enlarged schematic sectional view of a liner according to the present invention,

figure 2 is a schematic plan view of the method for laying strips of liner which form a continuous lining layer;

figure 3 is a highly enlarged sectional view, taken along the plane III-III of figure 2.

In the drawings, the reference numeral 10 generally designates the liner according to the invention, which is substantially composed of an intermediate geocompatible textile support 11 which separates two layers 12-13 of water-expandable material and of two further outer layers 14 and 15 of permeable geocompatible textile material which essentially have the function of containing and retaining the water-expandable material.

The intermediate support 11 has high mechanical-strength characteristics and imparts these characteristics to the liner essentially in order to make it self-supporting and prevent its collapse in case of installation on vertical or almost vertical walls with slopes of more than 45°. For this purpose, the support 11 is preferably made of flock-like geocompatible textile material with high imbibition power and with unit weight comprised between 150 and 1000 grams per square meter. Nylon-flock tight-mesh woven fabrics, and non-woven fabrics made of the same material, have been found to be particularly suitable for the purpose. In order to increase the imbibition power, said materials are advantageously pre-treated in a hot-air oven with temperatures comprised between 70 and 80°C; this treatment forms a surface flocking which has high water retention characteristics.

In order to improve the mechanical characteristics of said support, it can be further reinforced with metallic or geocompatible textile nets.

The layers 12 and 13 of water-expandable material are typically constituted by sodic bentonite (montmorillonite) with a silica percentage comprised between 30 and 70%. Alternatively, it is possible to use calcic bentonite or a mixture of sodic and calcic bentonites. As a further alternative, one layer may be made of sodic bentonite and the other one may be made of calcic bentonite, in order to give said layers the ability to swell in the presence of different liquids, for example sea water and fresh water.

Also in order to make said layers selective to liquids of different kinds, in particular to mixtures of chemically active components and liquids, sodic and/or calcic bentonite can receive the addition of organic expansion agents chosen with reference to the type of the above mentioned chemically active components. The material of said water-expandable layers is preferably in a granular form with a grain size comprised between 5 and 40 mesh, advantageously 25 mesh, and the thickness of the layers is comprised between 2 and 8 millimeters. The water-expandable material is contained by the surface layers 14 and 15, which are highly permeable in order to allow the passage of liquids inside the water-expandable layers 12 and 13.

For this purpose, the layers 14 and 15 are made of loose-mesh geocompatible fabric, typically of geocompatible gauze woven with polypropylene or polyester threads. Naturally, the "meshes" of said fabric are finer than the minimum grain size of the water-expandable material, in order to prevent its escape. In order to prevent the concentration of the material of the layers 12 and 13, the surface layers 14 and 15 are sewn to the intermediate support 11 with long stitches 16, briefly termed tacks, which substantially form a net for retaining the granular material. In replacement of the tacks, or in addition to them, the granular material of the

layers 12 and 13 can be treated with a non-toxic adhesive, advantageously with fish glues.

The liner material structured as described above is manufactured in strips S whose width is comprised between 1.5 and 5.50 meters and whose length is such that it can be packaged in rolls R which are sufficiently easy to handle.

During installation for the forming of sealed layers, for example of tanks V, basins and the like, the adjacent strips Sa-Sb...Sk are partially overlapped, as shown in figure 2, where ZSa...ZSk indicate the overlap regions of said strips.

With reference to figure 3, it can be seen that in said overlap regions ZS, in accordance which the stated aim and objects, the water-expandable material of the upper layer 13 of the strip Sa is adjacent to the lower layer 12 of the adjacent strip Sb. The water-expandable material of the two layers is separated only by permeable geocompatible fabrics for the containment of the two water-expandable layers. Therefore, said layers may be easily reached by the infiltration liquids even in said overlap regions, with the result that the lap joints are able to ensure, in the presence of infiltration liquids, the tightness of said joint by virtue of the expansion of the material of the adjacent layers, indicated by the arrows f in the figure.

Naturally, without altering the concept of the invention, the details of execution and the embodiments of the liner may be modified extensively with respect to what is described and illustrated by way of non-limitative example without thereby abandoning the scope of the invention.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the scope of each element identified by way of example by such reference signs.

Claims

1. Sealing liner, particularly for eliminating infiltrations, characterized in that it comprises a composite pack-like structure (12-15) having an intermediate support made of geocompatible textile material with high mechanical strength which separates two layers (12,13) of water-expandable material which are arranged adjacent to the opposite faces of said intermediate support (11), and in that each one of said layers of water-expandable material is delimited by further outer layers (14,15) for the containment of highly permeable geocompatible textile material.

2. Liner according to claim 1, characterized in that the intermediate support (11) is constituted by flock-like geocompatible textile material with high imbibition power and has a unit weight comprised between 150 and 1000 grams per square meter.

3. Liner according to claims 1 and 2, characterized in that said intermediate support (11) is constituted by a nylon-based woven fabric.

4. Liner according to claims 1 and 2, characterized in that said intermediate support (11) is constituted by a nylon-based non-woven fabric.

5. Liner according to claims 3 or 4, characterized in that said nylon-based intermediate support (11) is treated in a hot-air oven at a temperature comprised between 70 and 80°C.

6. Liner according to claim 1, characterized in that the water-expandable material of the layers (12,13) separated by the intermediate support (11) is constituted by sodic and/or calcic bentonite.

7. Liner according to claim 6, characterized in that organic expansion agents are added to said bentonite.

8. Liner according to claims 1 and 6, characterized in that said water-expandable material is the same for both layers (12,13).

9. Liner according to claims 1 and 6, characterized in that the water-expandable material which composes one layer is different from the one which composes the other layer.

10. Liner according to claims 1 and 6, characterized in that the material of the water-expandable layers is in granular form with a grain size comprised between 5 and 40 mesh.

11. Liner according to claim 1 and any one of claims 2 to 10, characterized in that the outside containment layers (14,15) are constituted by loose-mesh geocompatible woven fabric, typically geocompatible gauze.

12. Liner according to claim 11, characterized in that said fabric is made of polypropylene threads or flocks.

13. Liner according to claim 11, characterized in that said fabric is made of polyester threads or flocks.

14. Liner according to claim 1 and claims 11 to 13, characterized in that the material of the expandable layers is kept in place by tacking and/or by non-toxic adhesives.

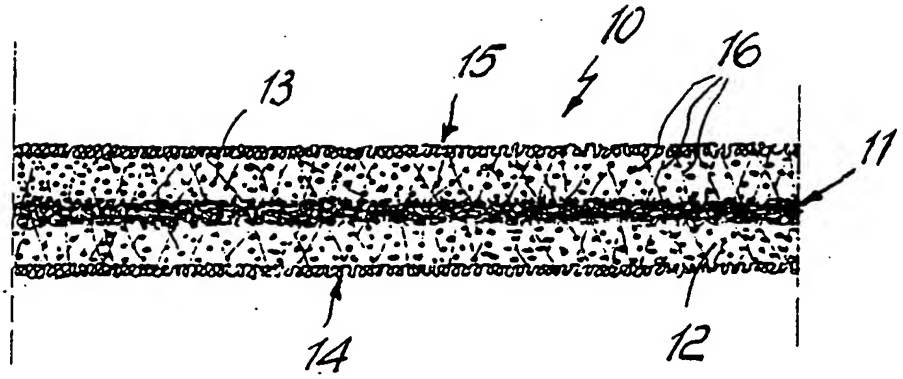
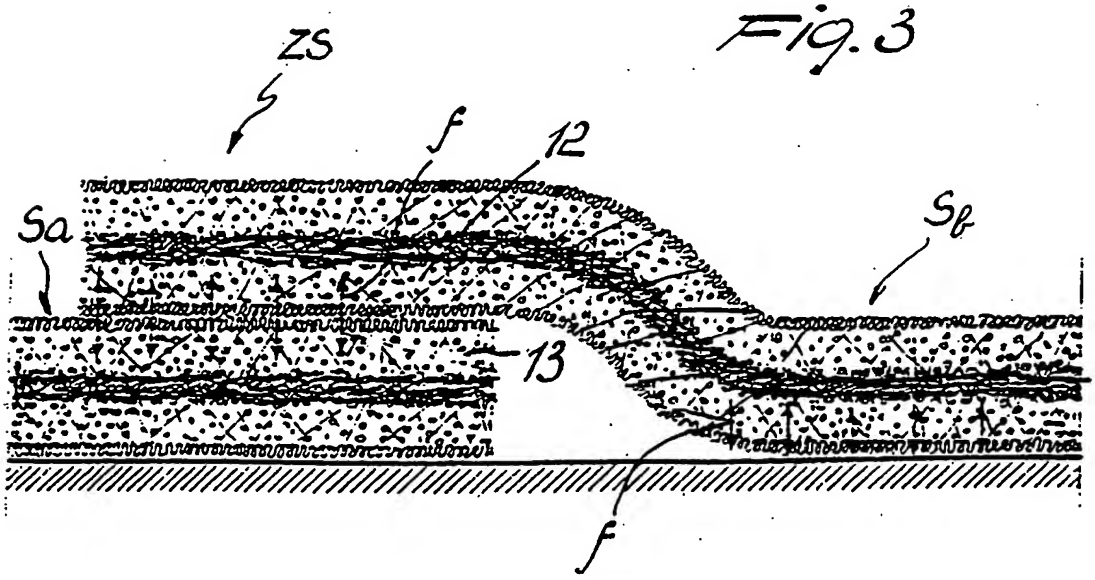


Fig. 1

Fig. 3



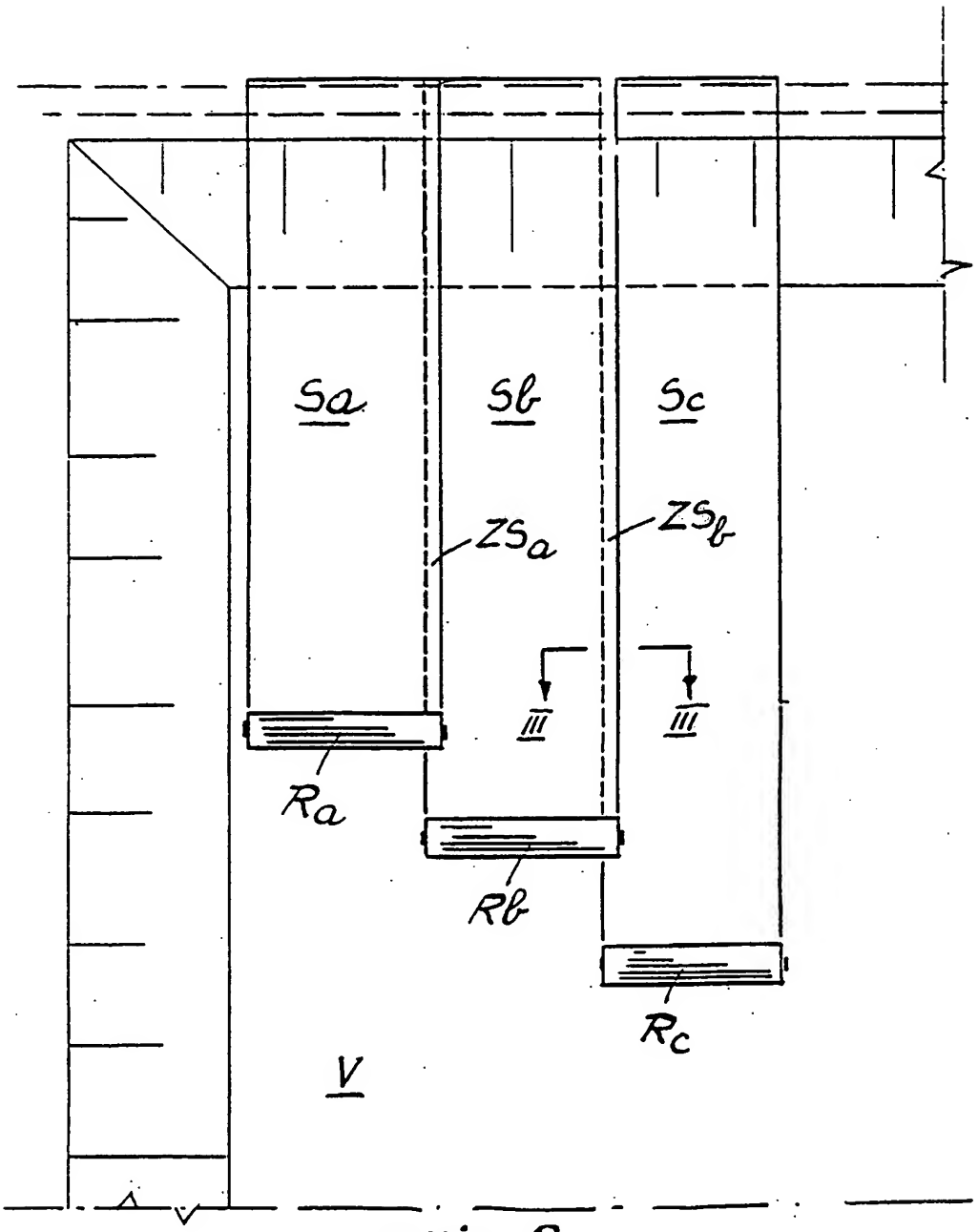


Fig. 2

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EUROPEAN SEARCH REPORT

Application Number

EP 92 11 1402

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	WO-A-9 014 222 (PARAMOUNT) * page 2, line 25 - line 27 * * page 3, line 29 - page 4, line 12 * * page 11, line 20 - page 12, line 15; figure 4 *	1,7,9, 10,14	E02D31/00
A	US-A-4 103 499 (CLEM) * column 2, line 13 - line 23 * * column 3, line 11 - line 45 * * column 3, line 57 - line 67; figures 1-3 *	1,6,8	
A	EP-A-0 278 419 (NAUE FASERTECHNIK) * page 2, line 17 - page 4, line 48 * * page 6, line 39 - line 40; figures 1,2 *	1-4,6, 11-13	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

E02D
B09B
B32B
E04B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	22 OCTOBER 1992	BELLINGACCI F.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
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& : member of the same patent family, corresponding document

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